PATENT SPECIFICATION 701,716

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COMPLETE SPECIFICATION.

Floating Hydraulic Power Plant especially for Irrigation and like Purposes.

I, CHALERM SAKUNWADHNA, of 38 Lovaine Place, Newcastle-on-Tyne 2, formerly of 71 Fern Avenue, Jesmond, Newcastle-on-Tyne, a Siamese Subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a floating hydraulic power plant which can be moored in a stream, such as a river or estuary, and convert the kinetic energy of the stream into useful power, for raising water from the stream and delivering it to irrigation systems on the banks of the stream, or/and for generating electricity or other purposes.

The floating power plant according to the invention comprises a floating hull or two substantially similar hulls connected together, which may conveniently be of rectangular plan form, provided with appropriately placed buoyancy and ballast chambers to make it or them float upright and level, and having formed in it or between them a longitudinal channel of venturi-shape in plan, the throat of the venturi being occupied by an undershot water-wheel delivering power, directly or through transmission means, such as spur, bevel, skew or worm gearing, chain or belt drive, or a combination of any of them to the machinery to be driven.

The channel may be open below or have a closed bottom, which may be flat and level.

The side walls of the convergent part of the venturi channel upstream of the throat are to be formed to a smooth curve to minimise dissipation of energy by eddy-formation in the entry of the venturi and up to the throat, while downstream of the throat the shape of the channel is of little importance and the channel may indeed terminate immediately downstream of the wheel, since turbulence in the tail-race is not detrimental.

The immersion of the wheel can be adjusted by adjusting the ballast of the hull; and by this adjustment optimum wheel-immersion for different conditions of stream velocity can be obtained.

The wheel is preferably of the shrouded type having integral end discs, which are preferably dished or conical so that the width of the wheel-vanes parallel to the axis diminishes from the circumference of the discs to the hub. The vanes may extend slightly beyond the discs, the extended extremities being of constant width. The vanes are preferably curved in the radial direction, being concave to the stream, with the curvature increasing from hub to tip.

According to another feature of the invention, a guide plate, pivoted about a horizontal transverse axis, situated above the water level near the entry of the venturi channel, spans the channel and extends from an intermediate point of the convergent part of the channel as far as the wheel, having only a small clearance from the vane-tips, and is provided with means of adjustment, such as a screw-jack, whereby the extent to which its trailing edge is submerged below the free water level and the angle at which it is inclined to the horizontal can be varied within limits. This guide plate, by confining from above the narrower end of the convergent part of the venturi channel, in effect forms a convergent nozzle, in which the stream has no free surface; and by adjusting the guide plate as mentioned above, the convergence of such nozzle, in terms of decrease of cross-sectional area along its length, can be varied. The trailing end of the guide plate may be thickened so that the upper surface of the plate is always above the free water level, the trailing extremity being curved in the vertical direc-

[*Price* 2*s.* 8*d.*]

Price 75p

tion to have approximately uniform clearance from the tips of the wheel-vanes.

A further feature of the invention, specific to the case in which the wheel is coupled to a pump or pumps for raising water for irrigation or other purposes, concerns the arrangement of the pump inlet, which comprises a hollow member extending across the throat of the venturi channel, one face of said member being occupied by an opening bordered by a narrow flange having a substantially constant clearance from the tips of the wheel-vanes, and extending circumferentially over a distance which is at least as great as and preferably slightly exceeds the vane-tip spacing, the upper edge of such flange being just below the water level on the downstream side of the wheel, at which position the tips of the curved wheel-vanes are substantially vertical just before they rise clear of the water. The suction pipe or pipes of the pump or pumps communicate with the interior of this hollow member. This arrangement ensures that the residual head of the stream, after parting with the maximum extractable energy to the wheel, is recuperated by the pump(s).

In a preferred constructional arrangement, two pumps of the double-acting reciprocating type are provided, the pumps being housed within the hull, one on either side of the venturi channel, below the water level, so that the pumps are self-priming. The pump delivery pipes may be connected to the shore by means of flexible hoses.

In use the hull will be moored in any position so as to ride to the stream with the venturi channel entry facing directly upstream.

A number of floating power plants as above described may be lashed together side-by-side if required; in which case one or more of them may have their wheels coupled to pumps, while the wheel(s) of another or others may drive an electric generator or generators, or other machinery.

It will be evident that the mobility of a floating power plant as above described considerably increases the scope of its uses, since it can easily be towed to different positions where its services may be needed.

The accompanying drawings illustrate by way of example a specific embodiment of the invention. In the drawings:—

Figure 1 is a plan view of the floating power plant;

Figure 2 is a sectional elevation on the line 2—2 of Figure 1;

Figure 3 is an end elevation viewed from the right hand end of Figures 1 and 2.

Referring to the drawings, the plant comprises a pair of similar and symmetrically arranged hulls 1, 2 connected together to form a single duplex hull structure. The mutually facing walls 5 of the hulls 1, 2 are vertical and curved in plan so as to define a bottomless channel of convergent plan form with respect to water flowing through the channel from left to right in Figures 1 and 2. The outer walls 4 of the hulls are vertical and parallel and the hulls are provided with ballast chambers 3 below and buoyancy chambers (not shown) above.

At the narrow end of the channel is mounted an undershot wheel comprising a hub 6, vanes 7, conical shrouding discs 8 and drum-like shroud extensions 9, the hub being mounted on an axle 10 supported in pedestal bearings 11 by the hulls 1, 2. The vanes 7 where bounded by the shroud discs decrease in width towards the hub but extend radially outwards of the shroud discs, their unshrouded extremities being parallel sided. In the radial direction the vanes are curved, being concave to the stream, their curvature increasing from root to tip.

At each end the axle 10 carries a gear wheel 12, each gear 12 meshing with a pinion 13 on the crankshaft of a double-acting reciprocating pump 14, the pumps 14 being mounted one on each hull, 1, 2, below the normal water level W.L. so that the pumps are drowned. The delivery pipes 15 of the pumps discharge through stop valves 16 into pipes 17, to which flexible hoses can be connected. The suction pipes 18 of the pumps are connected through cocks 19 to a hollow transverse member 20 spanning the gap between the hulls downstream of the wheel 6, 7 below the water line. Member 20 has an open face 21 bounded by a flange 22, the face of which is curved to an arc concentric with the wheel and having a small constant clearance from the tips of the vanes 7, whose curvature is such that vane-tips are vertical when they leave the water, as will be seen in Figure 2. If necessary, the member 20 may be provided with openings in its downstream wall, such as 29 (Figures 2 and 3) to reduce resistance to flow of the stream, if the volume of flow through the opening 21, if unobstructed, is greater than the capacity of the pumps to suck it away.

A horizontal transverse bar 23 spanning the gap between the hulls near the entry of the channel between them above the water line forms the pivot for rods 24 to which is attached a guide plate 25 completely spanning the narrower part of the channel. The lower face 25*a* of the guide plate 25 is nearly flat and its upper face 25*b* diverges from the lower face so that the trailing end of the guide plate is thickened and terminates at a curved face 25*c* having substantially uniform clearance from the tips of the vanes 7. A screw-jack 26 connected to the guide plate by a rod 27 and operated by a handwheel 28 serves to raise and lower the trailing end of the guide-plate and thus adjust the immersion and slope of its lower

face 25*a*, while the upper face 25*b* remains above the free water level.

The members 20, 23 serve to connect the hulls 1, 2 rigidly together, other connecting members (not shown) being provided as necessary.

In use, the complete floating plant is moored with its head, i.e. the left hand end in Figures 1 and 2, to the stream. The water passing through the convergent channel between the hulls is accelerated before encountering the wheel 6, 7, and the acceleration is increased by the guide plate 25 if lowered into a partially submerged position so as to form with the channel walls 4, 5 what is in effect a convergent nozzle.

What we claim is:—

1. A floating power plant comprising a floating hull or two substantially similar hulls connected together, provided with buoyancy and ballast chambers, thereby adapting it to float upright and level, and having formed in it or between them a longitudinal channel convergent in plan, its side walls being formed to a smooth curve in plan, at the narrow end of which channel is disposed an undershot water-wheel coupled directly or through transmission means to a driven machine or machines.

2. A floating power plant as claimed in Claim 1, in which the wheel has integral end discs shrouding the vanes.

3. A floating power plant as claimed in Claim 2, in which the end discs of the wheel are dished or conical, the axial width of the vanes diminishing from the circumference of the discs to the hub.

4. A floating power plant as claimed in Claim 3, in which the vanes of the wheel are curved in the radial direction, the curvature increasing from hub to tip.

5. A floating power plant as claimed in any preceding claim, including a guide plate pivotally mounted about a horizontal axis transverse of the channel near its entry and above the normal water level, said plate spanning the channel and extending from an intermediate point of the convergent part of the channel as far as the wheel and having a small clearance from the vane-tips, and means of adjusting the level of the trailing edge of the guide plate, so as to regulate the inclination to the horizontal of the guide plate and the immersion of its trailing edge.

6. A floating power plant as claimed in Claim 5, in which the guide plate is thickened towards its trailing extremity in such a way that its upper surface is always above the free water level, the trailing extremity being curved to conform to the circumference of the water-wheel and give it substantially uniform clearance from the tips of the wheel-vanes.

7. A floating power plant as claimed in any preceding claim, and including a pump or pumps driven by the water-wheel for raising water, and further comprising a hollow member extending across the throat of the channel and connected to the pump inlet(s), one face of which member is occupied by an opening bordered by a narrow flange having substantially constant clearance from the tips of the wheel-vanes and extending circumferentially of the water-wheel over a distance at least as great as the spacing of the vane-tips, and the upper edge of said flange being just below the water level on the downstream side of the wheel, and the wheel-vanes being so curved that their tips are substantially vertical just before they rise clear of the water.

8. A floating power plant constructed and operating substantially as herein described and as illustrated in the accompanying drawings.

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Chartered Patent Agents.

PROVISIONAL SPECIFICATION.

Floating Hydraulic Power Plant especially for Irrigation and like Purposes.

I, CHALERM SAKUNWADHNA, of 71 Fern Avenue, Jesmond, Newcastle-on-Tyne, a Siamese Subject, do hereby declare this invention to be described in the following statement:—

This invention relates to a floating hydraulic power plant which can be moored in a stream such as a river or estuary, and convert the kinetic energy of the stream into useful power, for raising water from the stream and delivering it to irrigation systems on the banks of the stream, or/and for generating electricity or other purposes.

The floating power plant according to the invention comprises a floating body or hull, which may conveniently be of rectangular plan form, provided with appropriately

placed buoyancy chambers and ballast to make it float upright and level, and having formed in it a longitudinal channel of venturi-shape in plan and preferably having a flat level bottom, the throat of the venturi being occupied by an undershot water-wheel delivering power, directly or through gearing or the like, e.g. spur, bevel, skew or worm gearing, chain or belt drive or a combination of any of them, to the machinery to be driven.

The side walls of the convergent part of the venturi channel upstream of the throat are to be formed to a smooth curve to minimise dissipation of energy by eddy-formation in the entry of the venturi and up to the throat, while downstream of the throat and shape of the channel is of little importance and the channel may indeed terminate immediately downstream of the wheel, since turbulence in the tail-race is not detrimental.

The depth of water in the venturi channel and, consequently, the immersion of the wheel can be adjusted by adjusting the ballasting of the hull; and by this adjustment optimum wheel-immersion for different conditions of stream velocity can be obtained.

The wheel is preferably of the shrouded type having integral end discs, which are preferably dished or conical so that the width of the wheel-vanes parallel to the axis diminishes from the circumference of the discs to the hub. The vanes may extend slightly beyond the discs, the extended extremities being of constant width. The vanes are preferably curved in the radial direction, being concave to the stream, with the curvature increasing from hub to tip.

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A further feature of the invention, specific to the case in which the wheel is coupled to a pump or pumps for raising water for irrigation or other purposes, concerns the arrangement of the pump inlet, which comprises a hollow member extending across the throat of the venturi channel, one face of said member being occupied by an opening bordered by a narrow rim or flange having a substantially constant clearance from the tips of the vane-wheels, and extending circumferentially over a distance which preferably slightly exceeds the vane-tip spacing, and situated with its upper edge just below the water level on the downstream side of the wheel, at which position the tips of the curved wheel-vanes are substantially vertical just before they rise clear of the water. The suction pipe or pipes of the pump or pumps communicate with the interior of this hollow member. This arrangement ensures that the residual head of the stream, after parting with the maximum extractable energy to the wheel, is recuperated by the pump(s).

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A number of floating power plants as above described may be lashed together side-by-side if required; in which case one or more of them may have their wheels coupled to pumps, while the wheel(s) of another or others may drive an electric generator or generators, or other machinery.

It will be evident that the mobility of a floating power plant as above described considerably increases the scope of its uses, since it can easily be towed to different positions where its services may be needed.

Dated the 5th day of October, 1951.

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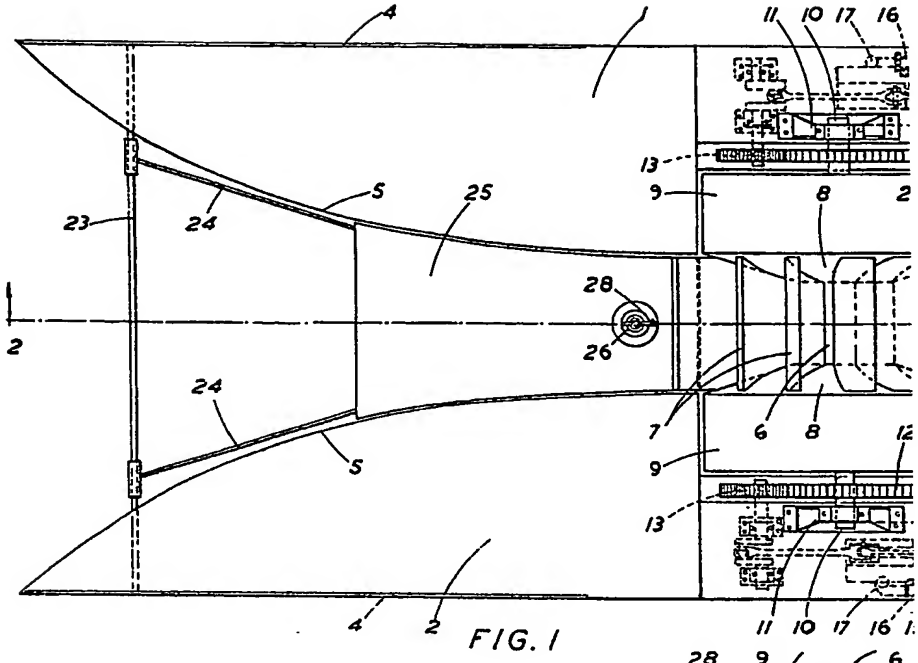

FIG. 1

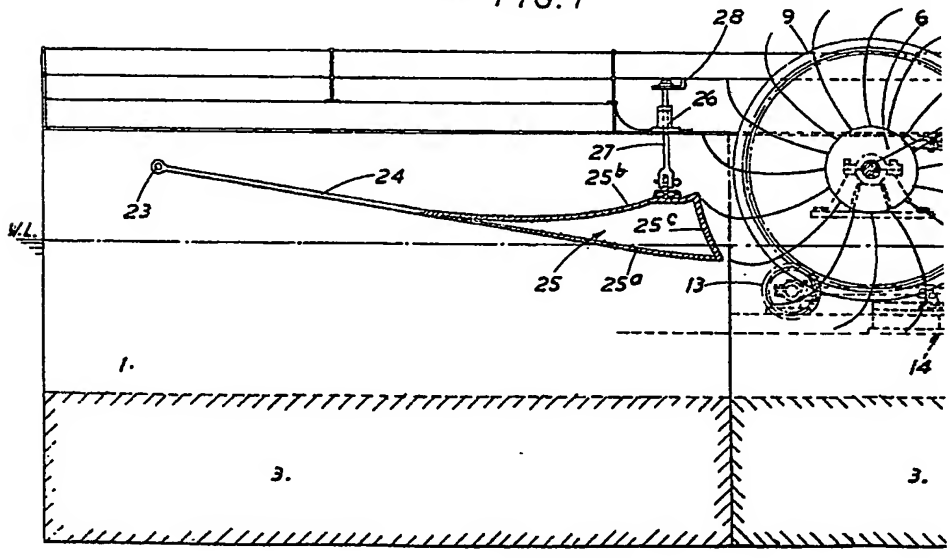

FIG. 2.

701,716 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale.*

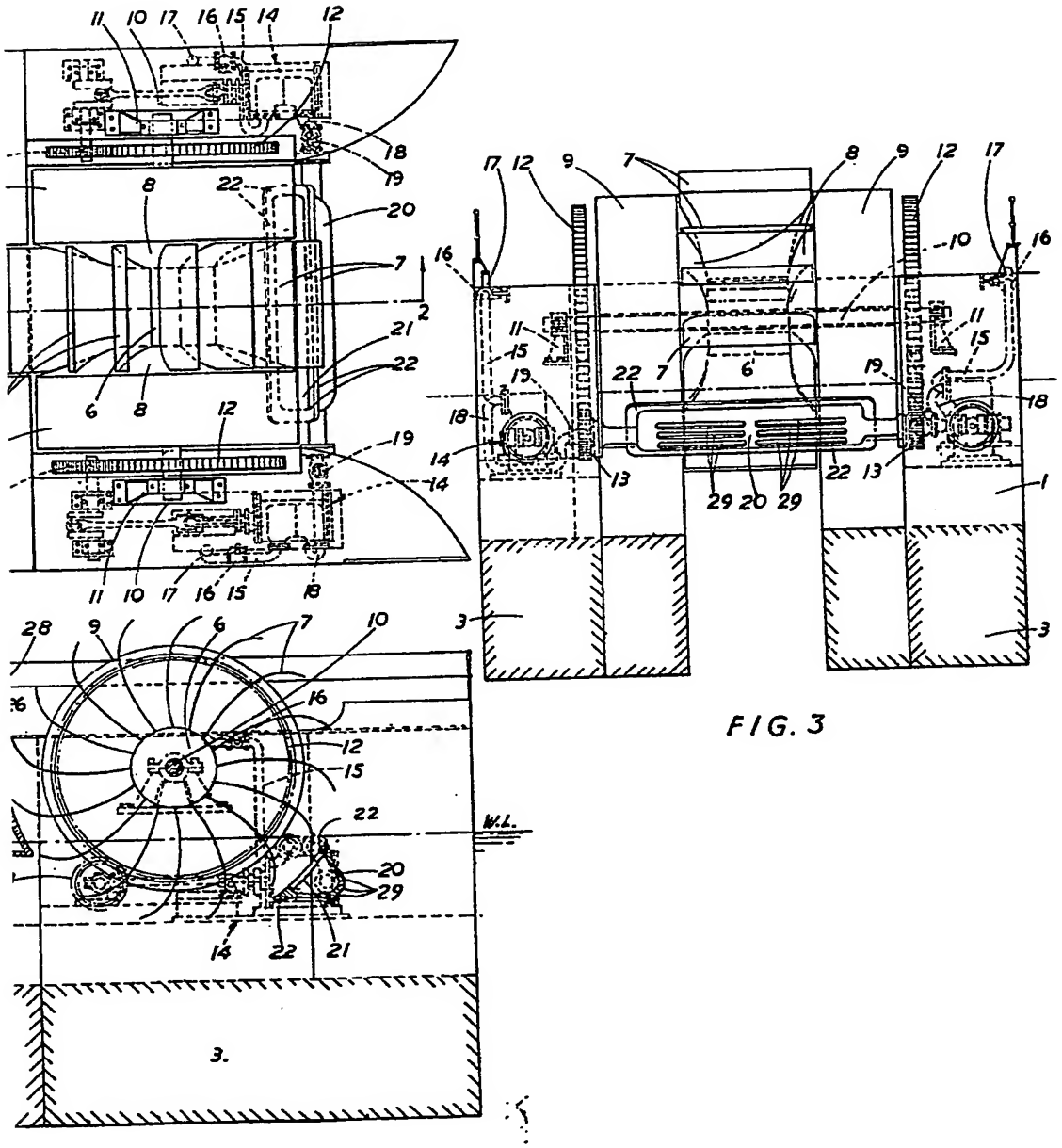

FIG. 3

701,716 COMPLETE SPECIFICATION
1 SHEET
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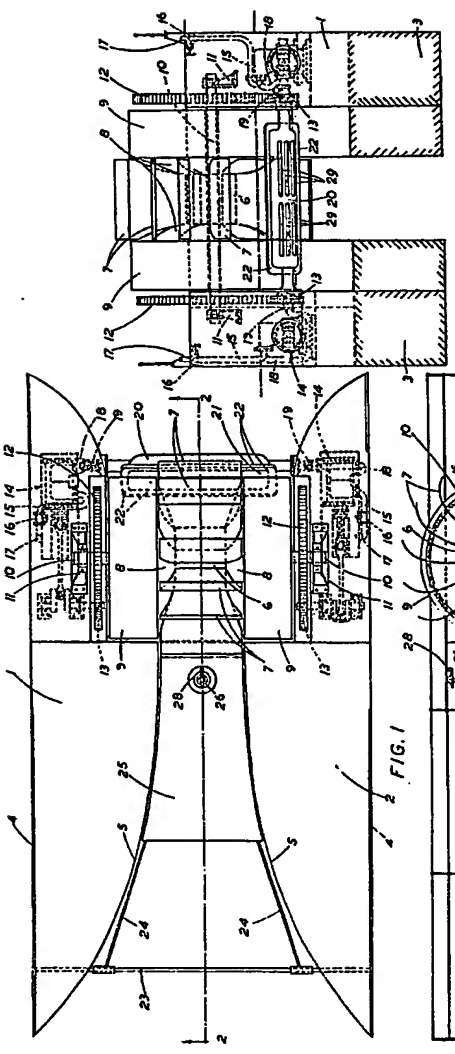

FIG. 3

FIG. 1

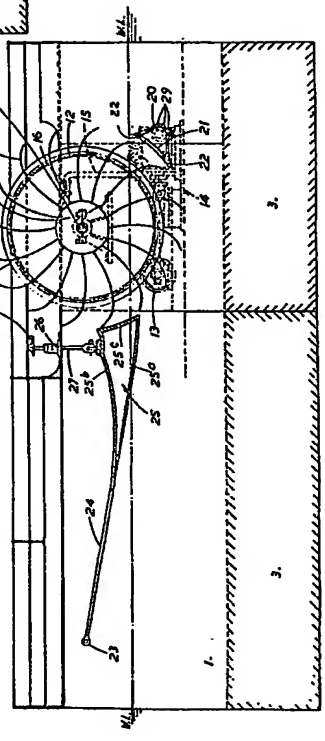

FIG. 2.